



# The entrepreneurial university, academic activities and technology and knowledge transfer in four European countries



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## ABSTRACT

This paper aims to provide an insight into academics' perceptions of an entrepreneurial university. In spite of all the initiatives, environmental changes and desire to create entrepreneurial universities, there is limited research on how the entrepreneurial orientation within a university may influence academics' engagement in different activities. Based on analyzing academics' survey responses at four European universities (University of Amsterdam, University of Antwerp, University of Ljubljana and the University of Oxford), our findings indicate that more academics in the natural sciences perceive their university department as being highly entrepreneurially oriented than their counterparts in the social sciences. The results also reveal that perceiving a university department as having a high or low entrepreneurial orientation may have a significant effect on whether an academic would engage in some activities that are more entrepreneurial in nature, but a negligible effect on whether an academic would engage in more traditional activities. Further, academics perceiving their university department as being highly entrepreneurially oriented are less likely to believe that engagement in technology and knowledge transfer can be harmful to academic science. At the end, the implications, limitations and future research areas are discussed.

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## 1. Introduction

Recently, the mutual relationship between the university and industry through the exchange of knowledge has become a global trend (Arvanitis et al., 2008). Since the early 1990s, environmental changes aimed at promoting the university's role in technology and knowledge transfer have spread across Europe (Grimaldi et al., 2011; Santoro and Bierly, 2006). Many European countries have introduced reforms and policy initiatives to encourage and improve university technology and knowledge transfer (Messeni Petruzzelli, 2011; Rasmussen, 2008).

Following these trends, a number of universities have transformed themselves from a traditional research university to an entrepreneurial university with strong ties to industry, thereby encouraging the entrepreneurial activities of their academics (Krabel and Mueller, 2009). Now the role of the entrepreneurial university is not simply producing new knowledge, but also disseminating this new knowledge to industry and society (Guerrero et al., 2012). The entrepreneurial university tries to provide a culture and suitable atmosphere for encouraging academics to disseminate their knowledge through

traditional academic activities as well as through activities that are more entrepreneurial in nature (Kirby et al., 2011; Philpott et al., 2011). The entrepreneurial university phenomenon brings some changes to university routines, culture and policies (Tijssen, 2006). Based on these changes, an entrepreneurial orientation within the university is starting to be formed (Todorovic et al., 2011). Yet, despite the growing awareness of the entrepreneurial university, little is still known about the entrepreneurial orientation within the university and how such an orientation there may influence academic activities (Todorovic et al., 2011).

There is a wide variety of activities through which academics transfer their new technology or knowledge (Bekkers and Bodas Freitas, 2008; Lockett et al., 2003). Some of these activities are more formal than others. Many prior studies have concentrated on more formal activities based on intellectual property rights as the main outcomes of universities such as patenting, licensing and the formation of spin-offs (D'Este and Patel, 2007). However, several studies (e.g. Abreu and Grinevich, 2013; Caldera and Debande, 2010; Cohen et al., 2002; D'Este and Patel, 2007; Scharfetter et al., 2001) emphasized that to most industries and universities less formal and informal as well as non-commercial activities are at least as, or even more, important as formal activities and agreements. Indeed, academics' engagement in less formal activities has been shown to provide an important economic and social value for both academics

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and industry partners (Abreu and Grinevich, 2013). In addition, the significance of informal interactions is highlighted by Audretsch et al. (2012). One of their concluding remarks is that there is a need for an increased focus and further research on informal technology and knowledge transfer (Audretsch et al., 2012).

Another neglected issue in the literature refers to the unit of observation. Previous studies focusing on technology and knowledge transfer have examined university incentives and the role of institutions, especially universities and university transfer offices, in fostering knowledge transfer (Krabel and Mueller, 2009; Landry et al., 2010). Fewer studies have examined factors that allow a deeper understanding of an academic who is actually the key actor in the technology and knowledge process (Jain et al., 2009; Krabel and Mueller, 2009; Rothaermel et al., 2007; Shane, 2004). Indeed, using the individual academic as a unit of observation provides a complete picture of actual engagement in academic activities (Grimaldi et al., 2011). In this way, all activities of an academic, disclosed as well as undisclosed, are considered. This is important since a number of studies argue that many academics do not always disclose all parts of their technology or knowledge transfer to the university administrators (Agrawal, 2001; Landry et al., 2010). Most prior studies focused on disclosed academic activities (Landry et al., 2010; Philpott et al., 2011) which underestimated the academics' overall engagement in technology and knowledge transfer (Grimaldi et al., 2011).

Further, there are some doubts about the influence and effects of university entrepreneurial orientation on the academic world. On one side, the commercialization of research generates revenues for the university that are usually reinvested in academic basic research (Grimaldi et al., 2011; Siegel et al., 2004). But, on the other side, commercialization activities may affect both teaching and basic research, which are the main missions of the university (Rasmussen et al., 2006). Therefore, there is still a fear among some academics that entrepreneurial orientation may hold the potential for conflict and may lead academics to neglect their main tasks (Arvanitis et al., 2008; Lee, 1996; Perkmann and Walsh, 2008; Rasmussen et al., 2006).

Although the entrepreneurial university phenomenon has gained attention and increased interest among academics and policymakers, there are still some gaps preventing a complete understanding of the university-industry relationship (D'Este and Patel, 2007; Geuna and Muscio, 2009). Thus, despite all the research and extensive literature on academic entrepreneurship and technology and knowledge transfer, this field of research still has some untapped issues that provide open space for some more and interesting further research (Wright, 2012).

In order to help close the identified research gaps, the objective of this paper is the following. First, we aim to find out how academics perceive the phenomenon of the entrepreneurial university. Based on individual academics' perceptions of the entrepreneurial orientation of their university department, they are divided into two groups. The first group includes those academics who perceive their university department as lowly entrepreneurially oriented (EO) and the second group includes academics perceiving their university department as highly EO. Our goal is to move beyond earlier work and provide contributions to the field of academic entrepreneurship and technology and knowledge transfer by answering research questions considering academics from all scientific disciplines and analyzing various academic activities through which technology and knowledge are transferred, including more entrepreneurial as well as more traditional ones. For the purposes of this study, the entrepreneurial activities refer to a wide range of activities ranging from more to less formal, such as patenting and licensing, business activity, collaboration, contract research, industry interactions, attendance at industry-sponsored workshops or meetings and applied research. While the term

traditional activities includes activities that are closer to the traditional missions of university such as participation at the conferences, scientific publishing, performing basic research and teaching.

Our study is based on a new data set of 1266 academics employed at four European universities: University of Antwerp (Belgium), University of Amsterdam (Netherlands), University of Ljubljana (Slovenia) and the University of Oxford (UK). In sum, this paper aims to provide an overall picture of academics' engagement in different activities by considering an individual academic and ascertaining how an individual perceives the entrepreneurial university phenomenon.

In the following section, we provide a theoretical background along with research issues and hypotheses development. Next, we provide a description of the research data and methodology. The empirical results are then presented. The paper concludes with a discussion, implications, limitations of this study and future research opportunities.

## 2. Theoretical background and hypotheses development

During the past 20 years many European Union countries have taken initiatives to improve university-industry relations and facilitate technology and knowledge transfer (European Commission, 2007). Although entrepreneurial universities have been facing similar challenges (Guerrero et al., 2012), reforms in national research systems aiming to increase the commercialization of research have affected universities in different ways (Grimaldi et al., 2011). Besides following the European common strategic goal, the "Lisbon Strategy", many countries have taken their own measures to encourage technology and knowledge transfer (Mazgan, 2011). Although a number of good practices have been identified that should help European countries realize goals regarding technology and knowledge transfer, each country has to choose the procedures and practices that are best designed for them and would be most effective in their context (European Commission, 2008). Therefore, different types of technology and knowledge transfer have been emerging in various conditions and industries (Mazgan, 2011). Thus, despite the common strategic goal and certain comparable economic and social conditions shared by European countries, entrepreneurial universities differ from each other due to their traditions, characteristics and policies that are unique to each university (Guerrero et al., 2012).

The literature review and prior research (e.g. Abreu and Grinevich, 2013; Bekkers and Bodas Freitas, 2008; Landry et al., 2010; Philpott et al., 2011) indicate that scientific discipline is likely to play a role in an academic's engagement in different activities of technology and knowledge transfer. As argued by Abreu and Grinevich (2013), in general academics in the natural sciences (engineering, physics and biological sciences) are more likely (relative to those in health sciences, the reference group) to engage in all types of activities through which technology and knowledge are transferred to industry, especially in more formal ones. Meanwhile, academics in the social sciences (education, business, arts and humanities) are more likely to be involved in less formal, informal and non-commercial activities (Abreu and Grinevich, 2013).

The differences in academics' perceptions about the entrepreneurial orientation of their university department are partly a reflection of different scientific disciplines, former relations with industry partners and diverging opportunities for engagement in various academic activities (Lam, 2010). It is quite natural that different departments across universities have more or less potential for entrepreneurial activities and vary in actual involvement in such activities (Davies, 2001). The latter, actual involvement in entrepreneurial activities, is largely associated with the environment surrounding academics. Namely, earlier research (e.g. Amabile et al., 1996; James and James,

1989) has emphasized that the environment in which an individual works is likely to have a great influence on an individual's behavior. As stressed by D'Este and Patel (2007), the environmental factors mainly influencing an academic's behavior are university culture, policies and routines. And changes in these factors are the main cause of the shift of a university from being traditional to a more entrepreneurially oriented one (Todorovic et al., 2011). Recently, many universities have introduced some changes to their culture and governance and thus taken measures to create an environment that supports and encourages the entrepreneurial activity of their academics (Grimaldi et al., 2011). Hence, it is important to assess the orientation of a university department from the standpoint of an individual academic since that provides information about how the individual perceives the surrounding environment, which is likely to influence their engagement in various activities (Hunter et al., 2011).

Prior research provided some evidence that academics are divided regarding attitudes to the entrepreneurial university (Lam, 2010). Namely, considering the scientific disciplines, the phenomenon of entrepreneurial university is much more accepted and supported by academics in the disciplines of engineering, science and medicine compared to academics in social science, arts and business (Philpott et al., 2011). However, Gascoigne and Metcalfe (2005) found that a number of academics in arts, humanities and social sciences perceive commercial work as a beneficial to their professional career, but at the same time those academics feel the lack of the adequate and supporting culture within university. An insufficient amount of funding available for social sciences is another reported factor in the literature that may contribute to the separation among academics in social and natural sciences in their perceptions and attitudes to the entrepreneurial university (Gascoigne and Metcalfe, 2005; Philpott et al., 2011). Despite the growing awareness in the literature on issues regarding the phenomenon of entrepreneurial university, there is still a scant knowledge about the academic's perceptions of department's entrepreneurial orientation in natural as well as social sciences.

To meet the aims of this study, the main research question of our study is whether there are any differences in behavior among academics who perceive their university department as highly EO and their counterparts perceiving their university department as lowly EO. Based on the above discussion, considering the findings of earlier research and aiming to clarify our main research question, we propose the first research hypothesis:

**H1.** Academics in the natural sciences are more likely to perceive their university department as highly EO than their counterparts in the social sciences.

Thus, in the first stage of the analysis two factors related to an academic's behavior, scientific discipline and entrepreneurial orientation of the university department, are considered simultaneously. In this way, we look at the association between scientific disciplines and whether an academic perceives their university department as highly EO or lowly EO. In other words, we assess whether academics in the natural sciences differ from academics in the social sciences in their perception of the entrepreneurial orientation of their university department. In addition, we are interested in finding out whether any differences exist in the extent to which academics engage in traditional or entrepreneurial activities between academics perceiving their university department as highly EO and those academics perceiving their university department as lowly EO. In order to accomplish this objective, we propose the following two research hypotheses.

**H2a.** Academics from highly EO university departments are more likely to engage in entrepreneurial activities than their counterparts from lowly EO university departments.

**H2b.** Academics from highly EO university departments are less likely to engage in traditional activities than their counterparts from lowly EO university departments.

On the other side, the introduction of the third mission, entrepreneurship, alongside the traditional missions of teaching and basic research brings some challenges and risks into the academic world (Philpott et al., 2011). Some academics still believe that the entrepreneurial university phenomenon is a threat to the university's two main missions of teaching and basic research (Philpott et al., 2011; Rasmussen et al., 2006). Even some successful entrepreneurial academics are anxious about their further academic performance (Lam, 2010). There is a concern that an entrepreneurial orientation within a university redirects academic research from basic to applied research (Etzkowitz, 2003). However, academics respond differently to the changing university environment and how each individual accepts and perceives these changes results in the individual's engagement in different activities (Lam, 2010). Thus, we propose that academics' perceptions of the environment around them play an essential role in their engagement in academic activities. Namely, it is important to know how academics perceive their university department's orientation, the support and encouragement for entrepreneurial activity, as well as how they perceive the influence of engagement in technology and knowledge transfer (T&KT) on academic science. This leads to the last research hypothesis.

**H3.** Academics from highly EO university departments are less likely to believe that engagement in T&KT can be harmful to academic science.

### 3. Methodology

#### 3.1. Sampling and data collection process

Guerrero et al. (2012) stress the importance of conducting academic entrepreneurship research in an international context. The great contribution in comparing universities from different countries with similar economic and social conditions is that it provides a real-world opportunity to learn about entrepreneurial academics, policymakers and practitioners (Guerrero et al., 2012). For the purposes of allowing the cross-cultural generalization of our findings, the study was conducted in four countries, the Netherlands, Belgium, Slovenia and the United Kingdom, at four universities: University of Amsterdam, University of Antwerp, University of Ljubljana and the University of Oxford. On one side, the selected universities are from four different countries which are all European Union members and thus share some similar economic and social conditions and have to follow the common strategic goals of the European Union. But, on the other side, these four universities differ from each other in their traditions, characteristics and policies which provide opportunities for fruitful research.

The universities analyzed in this study have different backgrounds. With its nine-centuries-long tradition, the University of Oxford was the first university in the English-speaking world (University of Oxford, 2013), while the roots of the University of Amsterdam date back to 1632 (University of Amsterdam, 2013). In contrast, the University of Antwerp and the University of Ljubljana are much younger universities. The University of Ljubljana was established in 1919 (University of Ljubljana, 2013) and the roots of the University of Antwerp go back to 1852, although the university as it is today was founded in 2003 following the merger of three existing university institutions (University of Antwerp, 2013). The University of Ljubljana is ranked, with its about 50,000 students, as one of the biggest universities in the world (Prodan, 2007), while in terms of number of employees, the University of Oxford has, with its

about 10,000 employees (University of Oxford, 2014), almost twice as many employees as the other three studied universities. In terms of surrounding environment, all four selected universities have been investing in the development of a friendly environment for promoting entrepreneurship and technology and knowledge transfer. However, there are some differences in the organization and characteristics of the surrounding environments due to the diverse policies and regulations of intellectual property rights and technology transfer at universities. Finally, according to the Academic Ranking of World Universities (ARWU Shanghai) for the year 2012, the University of Oxford took 10th place, followed by the University of Amsterdam in 122nd place, and the Universities of Antwerp and Ljubljana which were listed, respectively, among the 201–300 and 401–500 top universities in the world (ARWU, 2014). The latter summary of universities indicates just some of the differences among universities and thus, it is in line with many studies which suggest that despite some ultimate goals that universities may have, they differ in their traditions, histories and organizational structures (Martinelli et al., 2008).

In order to assure sample comparability, the academics were divided into five scientific disciplines (humanities, social sciences, natural sciences and mathematics, biomedical sciences and technological sciences) based on the Common European Research Classification Scheme (CERIF). Further, to assure better sample comparability academics from the humanities and social sciences were grouped together into one group named social sciences and academics from the natural sciences and mathematics, biomedical sciences and technological sciences were grouped together in another group called natural sciences due to the small share of respondents from the scientific fields of the humanities and technological sciences.

Based on the literature review, a survey instrument was developed using Dillman's (2007) tailored design method, which is a set of procedures for conducting successful, self-administrated surveys that produce both high quality information and high response rates. In addition, we followed Couper's (2008) directions for designing web surveys in order to provide a well-designed and effective survey instrument in a cost-effective manner. Two versions of the questionnaire were designed. Following the suggestions of Brislin (1976), the Slovenian version was prepared by translation of the initial English version of the questionnaire into Slovenian language and its back-translation. The translation was done by the authors of this study, while the back-translation into initial language was performed by a bilingual. The etic aspect was followed to achieve the generalization of results by designing the questionnaire items relevant to all cultures (Brislin, 1976). After the translation, we pre-tested the questionnaire. First, the questionnaire was reviewed by five individual experts and professors. Then, the questionnaire was sent to a group of potential respondents (academics from the University of Primorska, Slovenia). The feedback and comments of the experts, professors and pilot study were considered and incorporated in the design of the final version. Thus, the English version was administrated to academics at the Universities of Amsterdam, Antwerp and Oxford, while in the case of academics at the University of Ljubljana the questionnaire in Slovenian language was administrated.

All questionnaires were administrated electronically between the beginning of March and end of April 2013 to the email addresses of academics employed at all four universities. A personalized invitation letter to participate in the survey including a link to access the survey was sent to academics. The participation was entirely voluntary and a summary of the research findings was offered on request. The use of the same data-collection procedure by the same researchers improved the measurement equivalence across cultures (Antoncic and Hisrich, 2001; Sekaran, 1983). Data on all academics were collected using the websites of an individual university.

In total, 1300 questionnaires were returned, with 34 questionnaires being excluded from further analysis due to the high proportion of missing data (11 questionnaires had more than 20% of missing values) or not fulfilling the criterion of being employed at the university (23 questionnaires were responded to by an administrator or technician, a retired person, an emeritus or some other person not employed at the university). Missing data were found to be missing completely at random and therefore different imputation techniques could be used (Hair et al., 2010). Since the highest value of missing data for a single variable was 5.3%, in order to preserve the sample sizes two imputation techniques were applied (Antoncic and Hisrich, 2001; Hair et al., 2010). If less than half of the items were missing for a particular construct, then the within construct mean was used, otherwise the item mean based on all valid responses was used as an imputation value (Prodan, 2007). Thus, the final number of usable questionnaires is 1266, representing a valid response rate of 9.4%. Even though the response rate is low, in order to confirm that the academics included in the survey are representative of the overall population of academics, a comparison between the sample and the population was made for each university. The comparison reveals that the distribution of the sample is quite similar to the population of each university (see Table 1). The average respondent from all four universities was male, between 31 and 40 years old, held a PhD degree and described his research as mainly multidisciplinary.

### 3.2. Measurement instrument

All variables were measured through adequately modified scales previously tested and used by other researchers.

The entrepreneurial orientation of university departments was measured by the ENTRE-U scale developed by Todorovic et al. (2011). It should be noted that the original ENTRE-U scale was developed to be responded by department heads. Since the aim of this study was to capture an academic's perception and awareness of his/her department's entrepreneurial orientation and how such an orientation may influence an individual's engagement in various activities, the construct's items were slightly adapted for individual academic's responses. Furthermore, it was checked in the pre-testing phase of the questionnaire whether the ENTRE-U scale is an appropriate measure to use in the individual academic context. There were no issues raised about the items, constructing the ENTRE-U scale, to be too department level oriented by any expert, professor or academic from the pilot study. In addition, based on the theory pointing out the significance of environmental factors, such as department routines, university policies and culture, on individual academic's behavior (D'Este and Patel, 2007), we suggest it is important that each individual academic knows the department's issues and activities. Additionally, the scale was appropriately modified so that it could be used in different cultural contexts outside the initial cultural context of Canada (Todorovic et al., 2011). Respondents were asked to indicate the level of their agreement with 22 statements on a five-point Likert

**Table 1**  
Sample structure.

	University of Amsterdam	University of Antwerp	University of Ljubljana	University of Oxford
Sample size (no. of academics)	281	171	656	158
<i>Social sciences</i>				
Sample	58.7%	38.0%	31.9%	31.0%
Population	48.1%	42.6%	34.3%	32.9%
<i>Natural sciences</i>				
Sample	41.3%	62.0%	68.1%	69.0%
Population	51.9%	57.4%	65.7%	67.1%

scale, ranking from “strongly disagree” to “strongly agree” (for details, see [Table A.1 in the Appendix](#)).

Assessing whether the engagement in T&KT can be harmful to academic science, respondents were asked to indicate their level of agreement on a five-point Likert scale, ranging from “strongly disagree” to “strongly agree”, with the following statement: Engagement in T&KT has the potential to confuse the university’s central commitment to knowledge production (adapted from [Lam, 2010](#)).

All academic activities, traditional as well as entrepreneurial, were measured by the frequency of engagement in a particular activity or the time devoted to a particular activity. However, for the purposes of this study academics were divided into two groups regarding whether they were engaged in a particular activity or not. All academic activities except one (personal involvement in business) were measured for a period of the last 3 years due to measuring the academic’s recent and actual engagement in a particular activity. An academic’s personal involvement in business was measured for the last 10 years. Some activities were measured with more than one item. Namely, patenting was measured in terms of whether an academic (alone or as a member of a patent group) had applied for a patent or whether any patent had been granted to him/her (or to any member of their patent group) (adapted from [Prodan, 2007](#)); business activity was measured in terms of whether an academic had started any business based on his/her research results (adapted from [Arvanitis et al., 2008](#)) or had any kind of personal involvement in a spin-off or start-up business (adapted from [Bekkers and Bodas Freitas, 2008](#)); responses to the following three items: I have participated in joint research projects (research work undertaken with industry partners) (adapted from [D’Este and Patel, 2007](#)), I have provided a consulting service to private companies (adapted from [Landry et al., 2010](#)), and I have provided expertise or reports for private companies (adapted from [Arvanitis et al., 2008](#)), measured collaboration; industry interactions were measured with the four items adapted from [Ponomariov and Boardman \(2008\)](#) listed in [Table A.2 in the Appendix](#); while participation in industry-sponsored workshops and meetings was measured in terms of whether an academic had participated in workshops (adapted from [Bekkers and Bodas Freitas, 2008](#)) or meetings (adapted from [D’Este and Patel, 2007](#)).

In order to meet the aims of this study, the separation of academics regarding their perceptions of lowly or highly EO university department was the basis. Thus, academics were split into two groups based on the median value in the ENTRE-U scale.

### 3.3. Data analysis

IBM SPSS Statistics 20 was used for the descriptive analysis, cross-tabulation, t-tests, Pearson’s coefficient, reliability analysis and exploratory factor analysis (EFA). The reliability of the multi-item scales was measured by Cronbach’s  $\alpha$  ([Cronbach, 1951](#)). EFA was conducted using the Maximum Likelihood extraction method (and the Promax rotation method for the ENTRE-U scale) ([Hair et al., 2010](#)). Confirmatory factor analysis (CFA) was performed using the EQS 6.1 for Windows software ([Bentler and Wu, 2006](#)).

## 4. Findings

### 4.1. Empirical evaluation of the measurement scales

Internal consistency, which measures the reliability of a measurement scale, was assessed with Cronbach’s alpha for all scales used in this study ([Cronbach, 1951](#)). All of the Cronbach alphas indicated reliable scales for all four samples. In addition, EFA and CFA were conducted on two constructs that were measured with

more than three items to test the fundamental structures of the scales ([Prodan and Drnovsek, 2010](#)). In the context of measurement invariance, a multi-group confirmatory factor analysis was performed (MGCFA) ([Milfont and Fischer, 2010](#)). According to [Milfont and Fischer \(2010\)](#), the models assessing configural, metric and scalar invariance were tested. Considering the sensitivity of the chi-square difference test to the sample size and the large sample (1266 academics) used in this study, other goodness-of-fit indices, such as the root mean squared error of approximation (RMSEA), comparative fit index (CFI) and gamma hat (GH), were used to assess the model fit ([Chen et al., 2005](#); [Milfont and Fischer, 2010](#)). Partial measurement invariance ([Byrne et al., 1989](#)) was supported for both constructs (ENTRE-U and industry interactions). Since full measurement invariance is unlikely to hold in practice, partial measurement invariance may still enable appropriate cross-group comparison and provide meaningful results ([Antoncic, 2002](#); [Milfont and Fischer, 2010](#)).

EFA was conducted on all four samples to examine the initial factor structure of the ENTRE-U construct measuring the entrepreneurial orientation of the university department. Five items were eliminated from further analysis due to assuring construct equivalence among the four samples ([Singh, 1995](#)). As expected, EFA showed on four factors to explain the variance in the data. The Kaiser–Meyer measure of sampling adequacy was greater than 0.85 and Bartlett’s test of sphericity was statistically significant for all four samples. The explained variance ranged from 56.2% (University of Amsterdam), 58.8% (University of Oxford), 60.6% (University of Antwerp) to 61.7% (University of Ljubljana). In addition, CFA was applied to compare the first-order factor models and second-order factor model. Considering various fit indices suggested by several researchers (e.g. [Shook et al., 2004](#)), CFA confirmed that the second-order four-factor model provided the best results and are thus congruent with [Todorovic’s et al. \(2011\)](#) original scale. The reliabilities of the four dimensions for the Universities of Amsterdam, Antwerp, Ljubljana and Oxford, respectively, were the following: research mobilization 0.84, 0.87, 0.89 and 0.83, industry collaboration 0.81, 0.86, 0.86 and 0.85, unconventionality 0.87, 0.87, 0.85 and 0.86, and university policies 0.75, 0.81, 0.82 and 0.77. Performing the MCFA, first configural invariance was tested. The fit indices provided a good fit to the data (RMSEA=0.04, CFI=0.92 and GH=0.97). In the next step, metric invariance was confirmed since the decrease of fit indices between the models assessing configural and metric invariance of first-order factor loadings ( $\Delta$ RMSEA=0.000,  $\Delta$ CFI=0.005 and  $\Delta$ GH=0.003) as well as of the second-order factor loadings ( $\Delta$ RMSEA=0.000,  $\Delta$ CFI=0.002 and  $\Delta$ GH=0.000) was non-significant for any of the three fit indices ([Milfont and Fischer, 2010](#); [Vandenberg and Lance, 2000](#)). Additionally, the differences in fit between the model of metric and the model of scalar invariance did not support full scalar invariance ( $\Delta$ RMSEA=0.010,  $\Delta$ CFI=0.063 and  $\Delta$ GH=0.025). Therefore, a few intercepts were allowed to vary in order to test partial scalar invariance. The latter, partial scalar invariance, was supported ( $\Delta$ RMSEA=0.004,  $\Delta$ CFI=0.026 and  $\Delta$ GH=0.010).

EFA and CFA were conducted to empirically evaluate the industry interactions construct. The EFA indicated only one factor for all four samples. The value of the Kaiser–Meyer measure of sampling adequacy was good for all four samples since it was greater than 0.7 ([Field, 2009](#)). Bartlett’s test of sphericity was statistically significant for all four samples and the explained variance ranged between 37.3% (University of Amsterdam), 52.5% (University of Oxford), 54.7% (University of Ljubljana) and 55.9% (University of Antwerp). Cronbach’s alphas indicated a reliable scale among all four samples and the CFA confirmed a first-order one-factor model for each sample. In terms of measurement invariance, the model of configural invariance did fit the data well (RMSEA=0.03, CFI=1.00 and GH=1.00). Configural and metric invariance were supported ( $\Delta$ RMSEA=0.005,  $\Delta$ CFI=0.011 and  $\Delta$ GH=0.003), while scalar

**Table 2**  
Academics' perception of their university department as highly EO or lowly EO based on scientific discipline.

	Lowly EO uni. department (%)	Highly EO uni. department (%)	$\chi^2$
<i>University of Amsterdam</i>			
Social sciences	58.2	41.8	3.70
Natural sciences	46.6	53.4	
<i>University of Antwerp<sup>a</sup></i>			
Social sciences	40.0	60.0	3.98*
Natural sciences	25.5	74.5	
<i>University of Ljubljana<sup>a</sup></i>			
Social sciences	48.8	51.2	8.67*
Natural sciences	36.7	63.3	
<i>University of Oxford<sup>a</sup></i>			
Social sciences	42.9	57.1	4.66*
Natural sciences	25.7	74.3	

<sup>a</sup> Significant differences ( $\chi^2$ , \*  $p < 0.05$ ) in the proportion between the two scientific disciplines and the perception of whether the university department is highly EO or lowly EO.

invariance was not supported. However, after relaxing the constraint for one intercept, partial scalar invariance was supported ( $\Delta\text{RMSEA}=0.009$ ,  $\Delta\text{CFI}=0.024$  and  $\Delta\text{GH}=0.006$ ).

#### 4.2. Findings related to the hypothesized relationships

Hypothesis H1, predicting that academics in natural sciences are more likely to perceive their university department as highly EO than their counterparts in social sciences, is supported. The results indicate that the ratio of academics perceiving their university department as highly EO to those perceiving their university department as lowly EO in the two scientific disciplines is significantly different at three out of the four universities (the Universities of Antwerp, Ljubljana and Oxford have significant differences at  $p < 0.05$ , whereas the University of Amsterdam does not have a significant difference at  $p < 0.05$ , although it has a significant difference at  $p < 0.10$ ). These significant findings indicate the fact that academics in natural sciences perceive their university department as highly EO to a greater extent than academics in social sciences, where the difference in the share of academics perceiving their university department as highly EO or lowly EO is not so notable (see Table 2).

In addition, we also looked for the differences in the average academics' perceptions of department's entrepreneurial orientation at two different levels: the scientific discipline (within each university) and the university (between the universities). The results of the independent *T*-test indicate that there are significant differences in the average perceived entrepreneurial orientation between academics in social and natural sciences at three universities (the Universities of Amsterdam, Antwerp and Ljubljana have significant differences at  $p < 0.01$ , whereas the University of Oxford does not, however it has a significant difference at  $p < 0.10$ ). The significant differences show that academics in natural sciences perceive their university department more EO than their counterparts in social sciences. Furthermore, the results of the one-way ANOVA reveal that there exist significant differences in the average academics' perceptions of department's entrepreneurial orientation between universities. Namely, the only non-significant results are between the Universities of Antwerp and Ljubljana, and Antwerp and Oxford. The mean values of perceived department's entrepreneurial orientation for academics at Universities of Amsterdam, Antwerp, Ljubljana and Oxford, respectively, are 2.95, 3.18, 3.12 and 3.29.

The results shown in Table 3 indicate some significant differences in the proportion of academics' engagement in more entrepreneurial activities among academics who perceive their university department

as highly EO compared to those who perceive their university department as lowly EO. Considering the engagement of academics in each activity separately, the findings are as follows. The ratio of academics from highly EO university departments to academics from lowly EO university departments who engage in patent activity and license agreements is significantly different only in the sample of academics at the University of Ljubljana. There is no significant difference in the ratio of academics from highly EO university departments to academics from lowly EO university departments and their business activity for any university. In the case of collaboration activity, the results for the Universities of Amsterdam, Antwerp and Ljubljana are all significant. These results indicate that academics from highly EO university departments engage in collaboration activities to a greater extent than academics from lowly EO university departments. There is a significant difference in the proportion of academics from highly EO university departments to those from lowly EO university departments and their engagement in contract research as well as having industry interactions for academics at the University of Amsterdam and the University of Ljubljana. Significant differences between the two groups of academics in participation in industry-sponsored workshops and meetings are seen for academics at the Universities of Amsterdam, Ljubljana and Oxford. A significantly greater share of academics from highly EO university departments at the Universities of Amsterdam, Antwerp and Ljubljana do applied research than their counterparts from lowly EO university departments.

Table 4 reports the engagement of academics in more traditional activities. The perception of the university department's orientation significantly influences the participation in conferences only in the sample of academics at the University of Ljubljana. Namely, this finding indicates that academics from highly EO university departments attend conferences more often than academics from lowly EO university departments. However, it is important to note that the proportion of academics who participate at conferences is high in both groups of academics (90.3% of academics from highly EO university departments and 84.2% of academics from lowly EO university departments attend conferences). The share of academics who publish scientific papers does not significantly differ between the two groups of academics, those perceiving their university department as highly EO and those perceiving their university department as lowly EO, at any of the four universities. Considering basic research, significant results are only found for academics at the University of Ljubljana. Namely, a significantly greater share of academics from highly EO university departments at the University of Ljubljana does basic research than academics from lowly EO university departments. Nevertheless, in spite of the significant difference, the proportion of academics doing basic research is high in both groups of academics. Finally, there are no significant differences between the two groups of academics and their engagement in teaching at any university.

Looking at the academics' overall engagement in activities for all four universities, we come to the following conclusion. A great proportion of academics from both highly EO and lowly EO university departments at all four universities participate in all academic activities that are closer to the university's traditional mission. There is a large proportion of academics doing applied research, especially those from highly EO university departments (more than 70% at each university). Quite a large share of all academics, especially those from highly EO university departments, are engaged in less formal and informal activities such as collaboration (consulting and joint research), contract research, industry interactions and industry-sponsored workshops and meetings. More than 50% of academics from highly EO university departments at each university are engaged in these less formal and informal activities, whereas the share of academics from lowly EO university departments is a little lower but still exceeds one-third at each university. A quite small proportion of all academics is engaged in formal activities such as patenting, licensing and

**Table 3**  
Proportion of academics engaged in a particular entrepreneurial activity regarding lowly vs. highly EO university departments.

Entrepreneurial academic activities	Entrepreneurial orientation of university department			Entrepreneurial orientation of university department		
	Lowly EO (%)	Highly EO (%)	$\chi^2$	Lowly EO (%)	Highly EO (%)	$\chi^2$
	University of Amsterdam			University of Antwerp		
Patents	4.7	6.1	0.29	5.7	9.3	0.65
License agreements	5.3	3.8	0.37	9.4	7.6	0.16
Business activity	16.7	24.4	2.61	17.0	16.9	0.00
Collaboration	46.0	69.5	15.71***	39.6	60.2	6.21*
Contract research	56.0	71.8	7.48**	83.0	82.2	0.02
Industry interactions	55.3	71.0	7.33**	43.4	53.4	1.46
Industry-sponsored workshops and meetings	40.0	59.5	10.69**	39.6	55.2	3.50
Applied research	49.3	74.0	17.93***	64.2	79.7	4.67*
	University of Ljubljana			University of Oxford		
Patents	9.8	17.9	8.46**	6.1	12.8	1.59
License agreements	4.1	11.3	10.52**	8.2	8.3	0.00
Business activity	17.7	18.7	0.12	28.6	21.1	1.05
Collaboration	68.4	81.8	15.57***	63.3	70.6	0.85
Contract research	78.9	89.0	12.41***	67.3	67.9	0.01
Industry interactions	60.2	76.7	20.53***	65.3	68.8	0.19
Industry-sponsored workshops and meetings	50.4	72.3	32.79***	36.7	66.1	11.85**
Applied research	83.1	90.3	7.36**	63.3	74.3	2.00

\*  $p < 0.5$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

**Table 4**  
Proportion of academics engaged in a particular traditional activity regarding lowly vs. highly EO university department.

Traditional academic activities	Entrepreneurial orientation of university department			Entrepreneurial orientation of university department		
	Lowly EO (%)	Highly EO (%)	$\chi^2$	Lowly EO (%)	Highly EO (%)	$\chi^2$
	University of Amsterdam			University of Antwerp		
Conferences	90.7	92.4	0.26	86.8	86.4	0.00
Scientific publishing	89.3	81.7	3.36	84.9	81.4	0.32
Basic research	86.0	77.1	3.73	90.6	94.9	1.15
Teaching	88.7	80.9	3.30	77.4	63.6	3.19
	University of Ljubljana			University of Oxford		
Conferences	84.2	90.3	5.40*	89.8	92.7	0.37
Scientific publishing	88.7	89.7	0.17	89.8	93.6	0.69
Basic research	87.2	92.1	4.14*	91.8	88.1	0.50
Teaching	93.2	91.5	0.63	77.6	73.4	0.31

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

\*  $p < 0.5$ .

business activity. The share of academics engaged in patent or license activity ranges from 3.8% at the University of Amsterdam to 17.9% at the University of Ljubljana. The share of academics who are engaged in business activity is somewhat higher, but still does not exceed 30% at any university.

Based on our results, we can conclude that hypothesis H2a, which proposes that academics from highly EO university departments are more likely to engage in entrepreneurial activities, is partially supported. Out of the eight activities which describe the entrepreneurial activities of academics, for three activities (collaboration, industry-sponsored workshops and meetings, and applied research) at three universities, for two activities (contract research and industry interactions) at two universities and for two activities (patents and license agreements) at one university statistically significant differences between the two groups of academics were found.

Hypothesis H2b, which proposes that academics from highly EO university departments are less likely to engage in traditional activities than their counterparts from lowly EO university departments, is not supported. Namely, out of the four analyzed activities significant results were found only for two activities (conferences and basic research) at one university which in any case were in favor of the opposite group of academics than we had proposed.

Hypothesis H3, which predicts that academics from highly EO university departments are less likely to believe that engagement in T&KT can be harmful to academic science, is mostly supported. The shares of academics regarding their levels of agreement with the statement are reported in Table 5.

As can be seen in Table 5, at the Universities of Amsterdam, Antwerp and Oxford academics from highly EO university departments are less likely to believe that engagement in T&KT can be

harmful to academic science compared to their counterparts from lowly EO university departments (the differences are statistically significant for all three samples).

## 5. Discussion and implications

The present study provides some insight into the field of academic entrepreneurship and technology and knowledge transfer research by analyzing the extent and effects of EO university departments on the engagement of academics in various technology and knowledge transfer activities.

A wide spectrum of academic activities ranging from entrepreneurial to completely traditional was included in our study. Namely, just those more traditional and less entrepreneurial activities may often be the first stage in the further successful development of other more entrepreneurial activities (Philpott et al., 2011). Therefore, this study aimed to find out how an entrepreneurial orientation within the university is associated with academics' behavior by focusing on the engagement of individual academics in 12 different activities.

This study provides implications for theory and practice.

### 5.1. Theoretical implications

In order to move beyond prior research work, the suggestions of Todorovic et al. (2011) for future research were followed. Since their ENTRE-U scale was not created uniquely for the natural sciences, Todorovic et al. (2011) proposed that the entrepreneurial orientation of university departments in other disciplines as well as types of outcomes other than spinout creation and patenting should be investigated. Thus, in this study the entrepreneurial orientation of university departments in the natural sciences and social sciences was investigated along with how such an orientation is associated with academics' engagement in various activities.

Even though the phenomenon of the entrepreneurial university and its introduction as the third mission along with the missions of teaching and basic research is found around the world (Nelles and Vorley, 2011; Philpott et al., 2011), our research results indicate that the academic community is still divided into two parts regarding attitudes to the entrepreneurial university. The results show that a greater share of academics in the natural sciences perceives their university department as highly EO than their counterparts in the social sciences. Moreover, based on our results, we may also conclude that academics from highly EO university departments are less likely to believe that engagement in T&KT can be harmful to academic science compared to their

counterparts from lowly EO university departments. The latter finding once again indicates a divergence among academics in the attitude to the entrepreneurial university.

Our research results are congruent with Lam (2010) who emphasized that academics respond differently to the changing environment. The differences in academics' decisions on whether to interact with industry or not largely depend on the entrepreneurial orientation within their university (D'Este and Patel, 2007; Hunter et al., 2011). Most prior studies associated a university's entrepreneurial orientation with its external supporting factors from the environment surrounding the university, such as technology transfer offices, incubators, funding and different measures (D'Este and Patel, 2007; Di Gregorio and Shane, 2003; Hunter et al., 2011). Although a supportive environment is essential, it is not the only condition for a fruitful university–industry relationship. Here our contribution lies in identifying the entrepreneurial orientation within the university through the eyes of academics. Namely, our findings show that the academics' perception of their university's orientation is important since it has an influence on academics' actual engagement in some activities.

The results indicate that perceiving the university department as highly or lowly EO may have a significant effect on whether academics engage in some activities that are more entrepreneurial in nature, but conversely has a negligible influence on academics' engagement in activities that are more traditional. At this point, it is important to note that for two of the four universities studied, the University of Antwerp and the University of Oxford, only two or one significant results, respectively, were found. The non-significant results indicate there are no significant differences in the proportion of academics from highly or lowly EO university departments and their engagement in a particular academic activity. These differences in the significance of the results may be due to the uniqueness of each university. Indeed, despite sharing some similar economic and social conditions (Guerrero et al., 2012), only universities themselves can transform from being traditionally to entrepreneurially oriented by implementing the essential actions and changes in their structure and culture (Clark, 2001). It is therefore normal to expect that the extent and outcomes of the entrepreneurial orientation within universities will vary across countries and universities (Clark, 2001; Davies, 2001). Thus, we believe that analyzing these four universities provides an important insight into how the entrepreneurial university phenomenon is spread and accepted by academics across some parts of the European Union. Namely, universities differ from each other by their traditions, characteristics and taking their own measures in the national context but they all still need to follow the common European strategic goal of

**Table 5**

Differences in the levels of agreement with the statement among academics from highly and lowly EO university departments.

Engagement in T&KT has the potential to confuse the university's central commitment to knowledge production							
	Strongly disagree 1 (%)	2 (%)	3 (%)	4 (%)	Strongly agree 5 (%)	Mean	t
<i>University of Amsterdam<sup>a</sup></i>							
Lowly EO	4.0	14.0	32.7	40.0	9.3	3.37	
Highly EO	9.2	16.0	38.2	33.6	3.1	3.05	2.665**
<i>University of Antwerp<sup>a</sup></i>							
Lowly EO	1.9	15.1	45.2	30.2	7.5	3.26	
Highly EO	9.3	22.0	37.3	28.0	3.4	2.94	2.009*
<i>University of Ljubljana</i>							
Lowly EO	9.8	22.2	42.9	19.5	5.6	2.90	
Highly EO	9.7	22.3	38.9	23.6	5.4	2.93	−0.424
<i>University of Oxford<sup>a</sup></i>							
Lowly EO	8.2	26.5	34.7	24.5	6.1	2.95	
Highly EO	16.5	36.7	28.4	16.5	1.8	2.51	2.498*

<sup>a</sup> Significant differences ( $\chi^2$ , \*  $p < 0.05$ ; \*\*  $p < 0.01$ ) in the proportion between academics from highly EO and lowly EO university department and their disagreement/agreement on whether engagement in T&KT can be harmful to academic science.



becoming the most competitive and dynamic knowledge-based economy in the world (European Commission, 2003, 2007).

## 5.2. Practical implications

Nevertheless, despite the significant results partially confirming that academics from highly EO university departments are more likely to engage in some entrepreneurial activities and less likely to believe that engagement in T&KT can be harmful to academic science, we cannot state that academics from highly EO university departments are less likely to engage in more traditional activities. This is an important finding of our study for all those academics as well as university managers and policymakers who are afraid that the main missions of the university will be neglected upon the introduction of the third mission of entrepreneurship. Therefore, it is essential to convince academics of the validity and appropriateness of entrepreneurship and that it is not harmful to the missions of teaching and basic research as Philpott et al. (2011) already emphasized in their study. The latter is important since, as our results suggest, academics may still be found who believe that technology and knowledge transfer can be harmful to academic science.

In sum, this study holds important implications for university managers and policymakers. Overall, our findings indicate that the academics' perceptions about the environment surrounding them provide some important information regarding their engagement in various academic entrepreneurial and non-entrepreneurial activities. It is therefore not enough to simply announce the entrepreneurial orientation within the university, but it is crucial that the university persuades its academics to believe in it and creates a favorable attitude to entrepreneurship. In order to gain academics' attention and trustfulness, instead of just new policies and measures being written down, the university has to provide real support and take real actions. Through university initiative academic entrepreneurship should be introduced as a career path (O'Shea et al., 2005) in line with an academic career. Indeed, it is important that academics can actually feel and perceive that the establishment of the entrepreneurial phenomenon is not harmful to teaching and basic research and that achieving the right synergy among teaching, basic research and entrepreneurship is crucial to entrepreneurial university (Philpott et al., 2011). Hence, as Ponomariov and Boardman (2008) also already highlighted, policies and measures should be directed more towards the individual academic rather than the institution—the university itself.

## 6. Limitations and future research

The findings of this study should be considered to have a few limitations. First, academics who believed they did not participate in technology and knowledge transfer or did not have any links with entrepreneurship may have been less inclined to respond to the survey. Some, especially those in humanities departments, wrote that they thought they were not the relevant person for this study as they did not participate in technology or knowledge transfer. Second, there may be some bias in the data due to the self-reported measures. Third, although we chose four countries with similar economic and social conditions, some specific cultural

factors may still affect the results. Thus, future research could include other countries from the European Union. In addition, it would be interesting to compare our findings with findings based on samples of academics from the United States where the entrepreneurial university phenomenon started to spread around one decade earlier than in Europe. Fourth, despite the large sample used in this study, there are still some subgroups of academics that are too small for performing specific analyses. Namely, it would be interesting to see which activities break out by scientific discipline and department's entrepreneurial orientation. However, if academics are grouped based on the scientific discipline and department's entrepreneurial orientation, some subsamples (e.g. academics in social sciences engaged in patent and license activities) would be too small for performing an interaction analysis. Therefore, in future research a larger sample could be used in order to enable such kind of interaction analyses. Moreover, since the descriptive point of view has been selected for the current study, a more sophisticated analytic approach is beyond this study. Thus, it would be meaningful to use it in future research. As this study mainly analyzes differences among academics, their perceptions and acceptance of an entrepreneurial orientation within their university and the engagement of academics in various activities, it would be interesting to test the relationships between those constructs in future research; namely, how the perceived entrepreneurial orientation within the university actually influences the academics' engagement in various activities. It would be especially interesting to test the engagement in less formal activities which resulted as an important part of the academics' engagement in this study. In addition, the importance of those less formal activities as a type of technology and knowledge transfer between university and industry has also been emphasized by other researchers (e.g. Abreu and Grinevich, 2013; Caldera and Debande, 2010; Cohen et al., 2002; D'Este and Patel, 2007). Finally, a fruitful line of future research would be to analyze whether the perceptions of an entrepreneurially oriented university department might have an indirect effect through some other variables on academics' engagement in various activities.

## 7. Conclusions

This study contributes to a better understanding of the phenomenon of entrepreneurial university by finding out how academics from all scientific disciplines perceive and accept the entrepreneurial orientation of their university department. The findings reveal that there still exists a separation among academics in their attitude to the entrepreneurial university. Moreover, perceiving a university department as having a low or high entrepreneurial orientation may have an important effect on whether an academic would engage in some entrepreneurial activities, but a negligible effect on whether an academic would engage in more traditional activities.

Thus, despite the above mentioned limitations, we believe that our findings provide some significant theoretical and practical implications. At the same time, we hope that our study inspires others to conduct some further investigations in this area of research.

## Appendix A

See [Tables A.1 and A.2](#).

**Table A.1**

Entrepreneurial orientation of university departments: ENTRE-U scale (adapted from [Todorovic et al., 2011](#)).

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Research mobilization
Our department encourages graduate students to engage in research with significant implications for industry or society
Our department encourages students to seek practical applications for their research
In our department we emphasize applied research for industry
Compared to other similar departments in this province, our department has a reputation for its contribution to industry or society
Many of us conduct research in partnership with non-academic professionals <sup>a</sup>
At our department it is expected to make substantial contributions to industry or society
Industry collaboration
Our department is recognized by industry or society for its flexibility <sup>a</sup>
Our department is recognized by industry or society for its innovativeness
Our graduate students often secure high quality industry positions
Our department is highly regarded by industry
Our department encourages industry involvement in our research activities <sup>a</sup>
It is believed that our department should build relationships with industry
Unconventionality
Compared to other similar departments in this province, we are good at identifying new opportunities for collaboration with industry <sup>a</sup>
Our department supports us in collaborating with non-academic professionals
Our department tries to generate off-campus benefits from research projects
Our department seeks significant funding from sources other than the national research agencies to strengthen research work
Cooperation with organizations outside the university significantly improves our research activities.
We often seek research opportunities outside the traditional university environment
Compared to other similar departments in this province, we are known as very efficient researchers <sup>a</sup>
University policies
It is felt that research policies at this university contribute substantially to our department achieving its goals of research work
Compared to most other universities, our university is very responsive to new ideas and innovative approaches
Our university policies are best described as developed “bottom-up” using feedback from all levels of the university

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<sup>a</sup> Items excluded from the final analysis.

**Table A.2**

Industry interactions construct (adapted from [Ponomarev and Boardman, 2008](#)).

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Persons from a private company have asked for information about my research and I have provided it...
I have contacted persons in industry asking about their research or research interests...
I have helped place graduate students or post-docs in industry jobs...
I have worked directly with industry personnel in an effort to transfer or commercialize technology or applied research...

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